The analysis methodology described in Section 2 provides a basis for relating the size of a retention basin to its average performance as a stormwater quality control device, accounting for the intermittent and highly variable character of urban stormwater runoff. The calibration results presented indicate that performance projections, while not precise, are quite adequate approximations for use in planning activities. Because the calibration analysis covered a very wide range of physical basin types and sizes relative to the hydraulic loads applied, it is reasonable to consider the model suitable for use in a generalized analysis.

A generalized analysis is desirable because it addresses the following issues:

- Transferability: If information derived from a limited set of site specific monitoring data can be extended to other areas and other situations, its value is greatly enhanced. Transferrability of data and information was an important objective of the NURP effort.
- Adjustment: Monitoring programs appropriately emphasize conditions of higher stress which maximize the information content of a set of data. In this context, the storms monitored were consistently biased toward more severe events. Thus, for all test sites, the average of monitored storm events was significantly larger than the long-term average for all storms each particular basin can expect to treat. As a result, long-term performance will be better (perhaps appreciably) than performance under test conditions.
- Utility: NURP's emphasis was on planning tools, as opposed to a design or research emphasis. Accordingly, the information which can be developed should be structured in a format which assists planning activities.

In the results presented below, the analysis methodology is applied using rainfall characteristics as the basic input because long-term records are available for all areas of the country. Rainfall is converted to runoff parameters by applying a runoff coefficient, estimates of which are available from both NURP data and prior literature.

There are regional and local differences in rainfall patterns. Depending on the size and development of an urban area, runoff coefficients will vary. Feasible local options for basin surface area and depth will vary. Further, soluble fractions of certain pollutants may vary from site to site, as may typical particle sizes and settling velocities in urban runoff. Because of the foregoing, local analyses using site specific conditions are the most appropriate approach. Some general perspectives are possible, however, provided that it is recognized that local factors may modify results.

There are local differences in rainfall patterns within a region; however, based on rainfall records for 50 or more cities analyzed under the NURP program, fairly typical regional rainfall characteristics can be assigned (see Appendix Figure A-2). Detention basin performance for these rainfall patterns, for basins which have an average depth of 3.5 feet, and catchments which have a runoff coefficient of 0.2 are illustrated by Figure 11. The comparisons are based on TSS removal. The depth value shown is an average value: in effect, it defines the relationship between surface area and volume and is typical of the units in the NURP data base which has been analyzed. The runoff coefficient used is estimated, based on NURP data analyzed, to be fairly typical of the average for a large urbanized area. This figure, therefore, illustrates the order of differences in performance characteristics which can result from regional differences in rainfall patterns.

In Figure 11, and the other figures which follow, basin size is expressed as a (percentage) ratio between the surface area of the basin and the contributory urban drainage area. For example, an area ratio of 0.10% on the horizontal axis reflects a basin with a surface area of 0.64 acres serving a 1-square-mile (640-acre) urban drainage area. The performance relationships could alternatively be expressed in terms of basin volumes, although depth would also have to be shown in such a case because performance depends on both area and volume provided.

Figure 12 illustrates the effect of increasing average basin depth, and hence volume, using the Rocky mountain area rainfall statistics. Comparisons are based on TSS removal. Note that, for basins which provide area ratios in the order of 0.10%, doubling the volume (7 versus 3.5 foot depth) may improve removal efficiency as much as 20%. However, for relatively large basins, increased depth improves performance only marginally.

Since detention basin performance depends on runoff, rather than the rainfall which must be used for long-term projections, the runoff coefficient assigned (ratio of runoff to rainfall) is quite important. The value of 0.2 assigned in Figure 12 is estimated to be a representative value of an average for broad urbanized areas, and hence useful in providing an estimate of overall areawide requirements. However, the procedure may also be used to identify detention basin requirements for smaller, specific urban areas. In such cases, the runoff coefficient may either be lower (low density residential areas) or higher (commercial, very high density residential). The significant effect of runoff coefficients on performance in shown by Figure 13, using rainfall characteristics typical of the Northeast, and TSS removal for the comparison.

A set of detention basin performance charts may be developed using the NURP analysis methodology, and appropriate local factors, to provide a working guide for planning decisions. The previous performance charts were based only on TSS removal to simplify the comparisons which were made. For planning activities, however, estimates of removals for other pollutants of interest would be desireable.

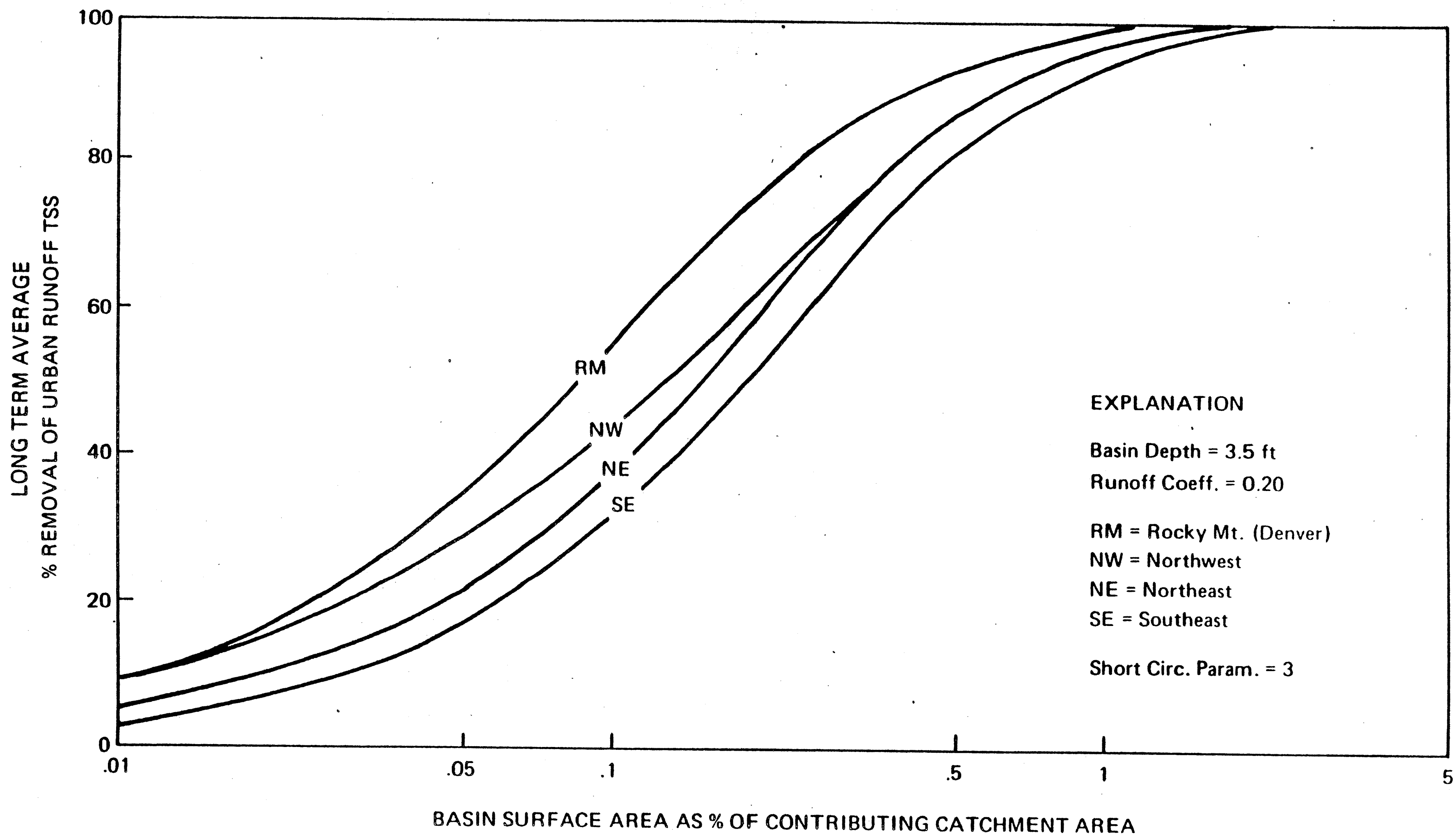


Figure 11. Regional differences in detention basin performance

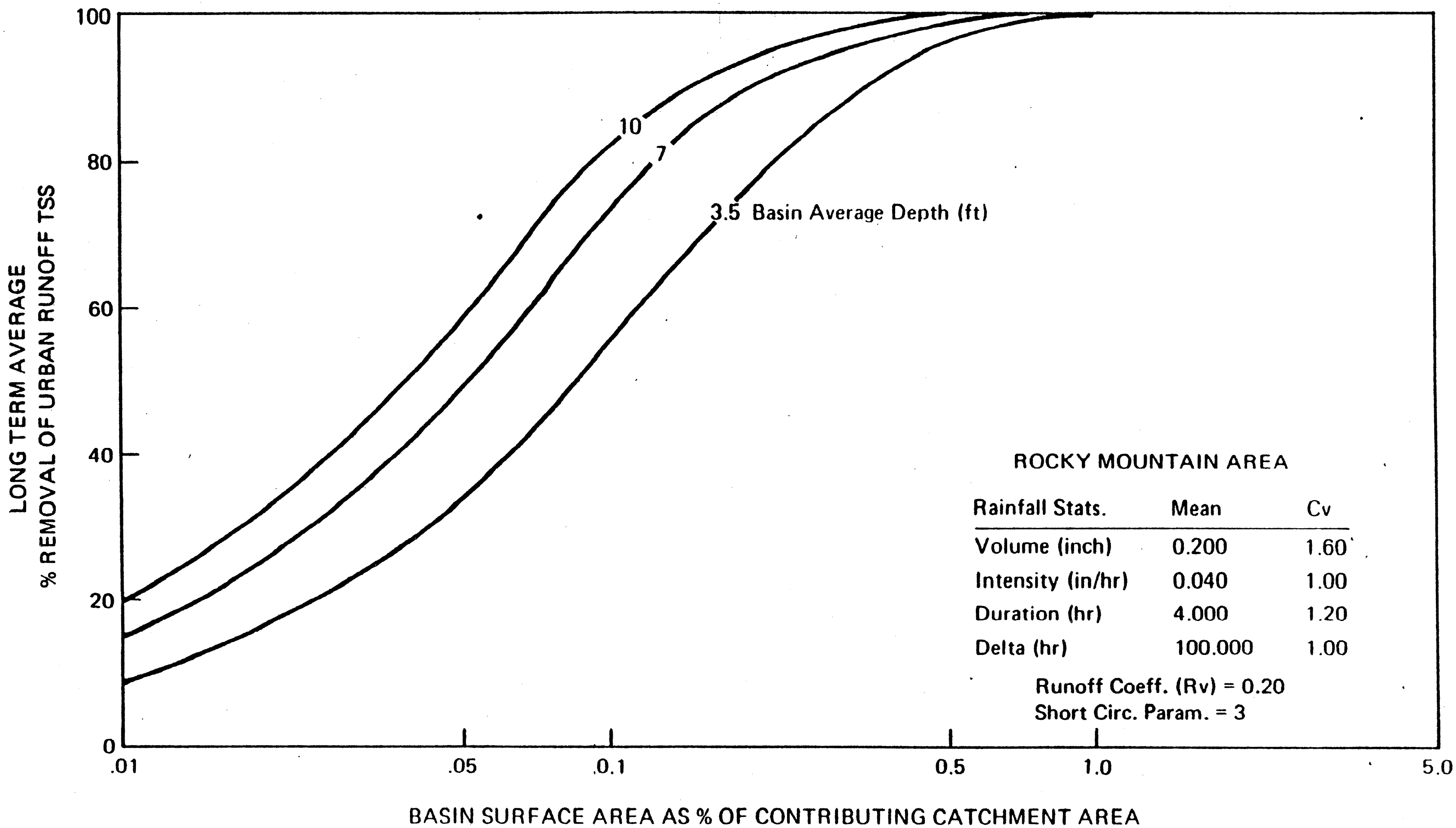


Figure 12. Effect of depth (volume) on performance

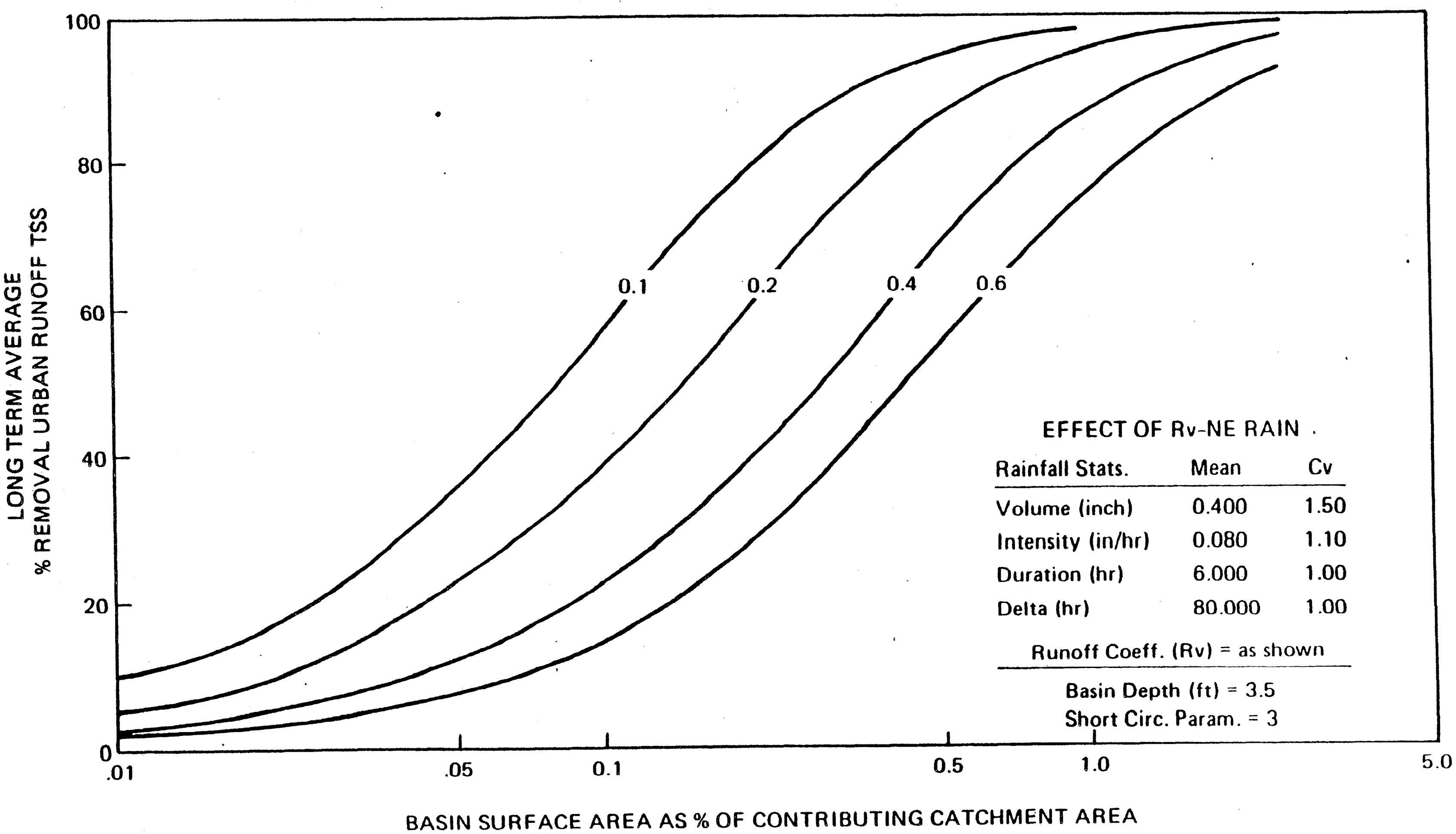


Figure 13. Effect of runoff coefficient on performance

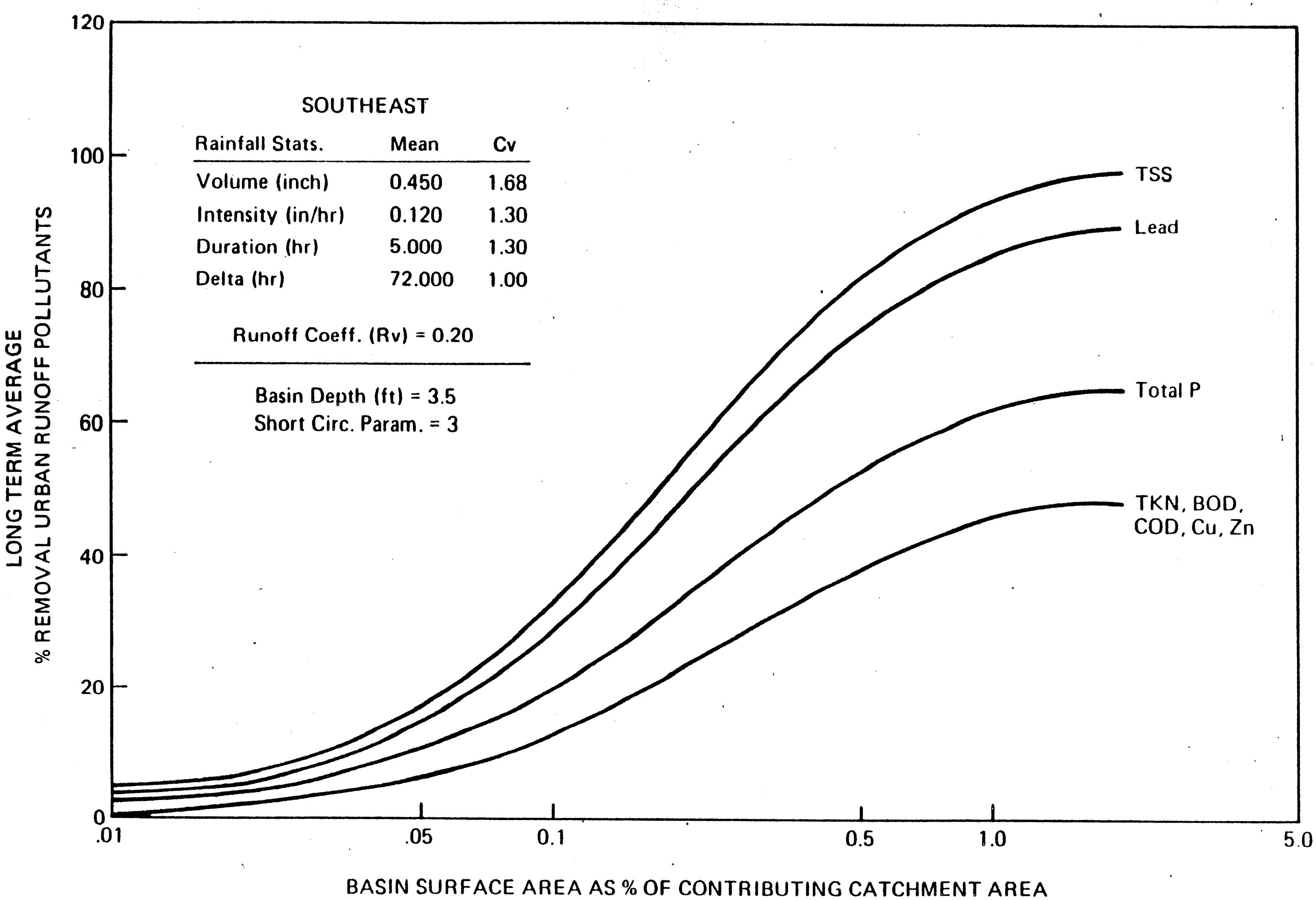


Figure 14. Detention basin performance

An illustration of such a chart is presented by Figure 14, using Southeast rainfall patterns, a basin average depth of 3.5 feet, a runoff coefficient of 0.20, and the particulate fraction of specific pollutants developed in the calibration analysis. The particulate fractions for lead (0.9) and total P (0.67) employed for this projection are typical values for urban runoff, based on the NURP data base. For TKN, Cu, Zn, BOD and COD, the estimates of particulate fraction (0.5) are based on more limited NURP data and are less certain.

In the absence of appropriate local data, the NURP estimates derived from a very large data base would provide the best estimate. However, where a local monitoring program is planned, such estimates and performance projections can be refined if the relevant analytical determinations are incorporated into the monitoring program.